

THIS OPINION WAS NOT WRITTEN FOR PUBLICATION

The opinion in support of the decision being entered today (1) was not written for publication in a law journal and (2) is not binding precedent of the Board.

Paper No. 40

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte NAOMI FUJIMORI, AKIHIKO IKEGAYA, TAKAHIRO IMAI,
NOBUHIRO OTA and TAKAYUKI SHIBATA

Appeal No. 1996-3121
Application No. 08/115,783

HEARD: February 23, 2000

Before KIMLIN, JOHN D. SMITH, and WARREN, Administrative
Patent Judges.

JOHN D. SMITH, Administrative Patent Judge.

DECISION ON APPEAL

This is an appeal pursuant to 35 U.S.C. § 134 from the final rejection of claims 1, 3-9, and 13-15.

Appealed claims 1 and 13 are representative and are reproduced below:

1. A method for producing diamond by a CVD method comprising:

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decomposing and reacting a reaction gas containing carbon atoms, hydrogen atoms, oxygen atoms and nitrogen gas, a concentration of carbon atoms in relation to hydrogen gas being (A%), a concentration of nitrogen gas in relation to the whole reaction gas being (B ppm), and a concentration of oxygen atoms in relation to the hydrogen gas being (C%), the amounts of A, B and C satisfy the equation:

$$" = (B)^{\frac{1}{2}} \times (A - 1.2C)$$

wherein " is not larger than 13 or B is not larger than 20, and wherein said carbon atoms comprise 99.9% or more of ¹²C or ¹³C.

13. A synthetic diamond which is formed by a CVD method on a substrate made of a material selected from the group consisting of copper-tungsten alloy, gold, silver, copper aluminum, a ceramic and a synthetic Ib type diamond single crystal, wherein at least 99.9% of carbon in the synthetic diamond comprises at least one carbon isotope selected from the group consisting of ¹²C and ¹³C, a nitrogen content in the synthetic diamond is less than 20 ppm, and a ratio of a peak height of non-diamond carbon to that of diamond in the Raman spectroscopic spectrum of the synthetic diamond is not larger than 0.07.

As evidence of obviousness of the claimed invention, the examiner relies on the following references:

Seitz	3,895,313	Jul. 15, 1975
Sakamoto et al. (Sakamoto)	4,725,345	Feb. 16, 1988
Yamazaki	5,015,494	May 14, 1991

A reference relied upon by appellants is:

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Strong et al. (Strong)¹, "Further Studies on Diamond Growth Rates and Physical Properties of Laboratory-Made Diamond", The Journal of Physical Chemistry, Vol. 75, No. 12, 1971, pps. 1841-43.

Appealed claims 14 and 15 stand rejected under 35 U.S.C. § 112, first paragraph, "enablement requirement". Appealed claims 1, 3-7, 9 and 13-15 stand rejected under 35 U.S.C. § 103 as unpatentable over Yamazaki combined with Seitz. Appealed claims 1, 3-9 and 13-15 stand rejected under 35 U.S.C. § 103 as unpatentable over Yamazaki and Seitz further in view of Sakamoto.

The subject matter on appeal is directed to a synthetic diamond coated on a substrate (appealed claims 13 and 15) and a method for producing diamond by a chemical vapor deposition(CVD) technique² (appealed claims 1, 3-9, and 14) which involves the decomposition and reaction of a reaction

¹ The Seitz patent refers to the Strong publication with respect to its disclosure of the absorption spectrum of synthetic diamond having dispersed nitrogen impurities. See Seitz at column 3, lines 60-68.

² Appellants exemplify and utilize various prior art CVD techniques including microwave plasma CVD and hot filament CVD. See the specification at page 3, lines 1-4.

gas³ which includes, inter alia, essentially isotopically pure carbon atoms which comprise "99.9% or more of ¹²C or ¹³C", hydrogen atoms, oxygen atoms, and nitrogen gas. Additionally, the concentration of the carbon atoms, the oxygen atoms, and the nitrogen gas must satisfy an equation set forth in the appealed method claims (see appealed claim 1 above) wherein " is not larger than 13. Alternatively, according to claim 1, the nitrogen gas is not larger than 20 ppm based on the total reaction gas present. Significantly, appellants disclose that by increasing the purity of carbon isotope utilized in the claimed method, diamond having an a higher coefficient of thermal conductivity is produced. See the specification at pages 16 and 17. This makes the diamond layer or film produced by the claimed method more desirable, when, for example, it is used as a heat sink for a high output integrated circuit or a laser diode. See the specification at page 2, lines 1-3.

³ Sources of carbon for appellants' process include, inter alia, methane and ethanol. See example 3 in the specification at page 13.

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THE 35 U.S.C. § 112, FIRST PARAGRAPH ENABLEMENT

ISSUE

Appealed claims 14 and 15 stand rejected under the first paragraph of 35 U.S.C. § 112, for the stated reason that "the disclosure is enabling only for claims limited to the substrates disclosed in the specification." The examiner further asserts that the claim language "metals having a thermal conductivity of at least the thermal conductivity of copper-tungsten alloy" covers substrates "not contemplated, given that high-W alloy has a very low conductivity." See the answer at page 3.

For a proper rejection under the enablement provision of 35 U.S.C. § 112, it is incumbent upon the examiner to provide, in the first instance, factual evidence and/or scientific reasoning that one of ordinary skill in the art would be required to resort to undue experimentation to practice the invention as defined by the scope of the claims. In re Strahilevitz, 668 F.2d 1229, 1232, 212 USPQ 561, 563-564 (CCPA 1982). In the present case, the examiner has presented no such persuasive evidence or reasoning which supports the conclusion that a skilled artisan would be unable to practice

the claimed invention without undue experimentation when using metallic substrates having thermal conductivities at least as high as copper-tungsten alloy. Compare the specification at page 6, lines 10-17. Moreover, the mere possibility that a claim covers an inoperable species does not render it unduly broad. In re Kamal, 398 F.2d 867, 872, 158 USPQ 320, 324 (CCPA 1968). The examiner's rejection of claims 14 and 15 is reversed.

THE REJECTIONS FOR OBVIOUSNESS

As evidence of obviousness of the claimed invention, the examiner principally relies upon Yamazaki. In a similar manner as described by appellants, Yamazaki discloses that diamond coatings may be formed on substrates by a microwave enhanced CVD process in which a carbon compound containing reactant gas including, inter alia, methanol⁴ diluted with hydrogen gas is decomposed in a reaction chamber to produce a diamond film on an underlying substrate such as the "super hard metal", tungsten carbide⁵. In addition to the carbon

⁴ See column 3, lines 40-43.

⁵ See column 2, lines 1 and 2 of Yamazaki.

compound, nitrogen gas is also "inputted" to the Yamazaki reaction chamber to prevent the growth of lattice defects in the diamond film. See column 1, lines 60-64.

The equation set forth in appealed claim 1 (which defines " in terms of the nitrogen gas concentration B, the carbon atom concentration A, and the oxygen atom concentration C) is not disclosed in the prior art references relied upon by the examiner. The examiner contends, however, that Yamazaki's described use of reactant gas mixture of methanol⁶, hydrogen and nitrogen would necessarily satisfy the requirements of appellants' " equation, and appellants have not specifically challenged the examiner's factual finding. See the answer at page 3. Therefore, we accept this finding as correct. Accordingly, Yamazaki identically describes a CVD process for producing diamond as required by appealed claim 1 with the exception of the requirement that the carbon atoms must comprise "99.9% or more ¹²C or ¹³C". The narrow question thus

⁶ Since methanol is the sole source of the carbon and oxygen atoms in the prior art CVD plasma, the factor (A -1.2C) in the equation is a negative number and thus the " value is also a negative number. Therefore, the calculated " value is less than 13 as required by the appellants' claims for this prior art embodiment.

raised by the examiner's obviousness rejection of appealed claim 1 is whether or not a person of ordinary skill in this art would have been led to utilize an isotopically pure source of carbon as required by appellants' claim in the prior art microwave enhanced CVD process described by Yamazaki. For the reasons below, we answer this question in the affirmative.

Seitz, the "secondary reference" relied upon by the examiner, discloses that the thermal conductivity of synthetic diamond can be enhanced by growing the diamond "from only one or the other of the isotopes of carbon 12 and carbon 13". See column 2, lines 19-24 of Seitz. Appellants point out that Seitz relates to a super high pressure method for forming synthetic diamond, because "[T]he diamond of Seitz⁷ seems to be produced by the method described in the Strong... article". See pages 2-4 of appellants' reply brief filed on February 28, 1995. Accordingly, appellants argue that there is no justifiable motivation "for combining a super high pressure method with a low pressure CVD method". See the brief at page 10. On the other hand, we note that although Yamazaki is

⁷ See footnote 1 of this decision.

principally concerned with the formation of diamond films possessing "high hardness" as coatings for the super hard metal substrates such as tungsten carbide, the thermal conductivity of the CVD produced diamond is a property of interest to Yamazaki. See column 5, lines 49-51 of Yamazaki. As appellants acknowledge in their specification at page 1, lines 15-18, and page 2, lines 1-3, because diamond has a "very large coefficient of thermal conductivity", it is especially useful as a heat sink for integrated circuits and laser diodes. Accordingly, in light of the relevant disclosures in Seitz and motivated by the goal of enhancing the thermal conductivity of Yamazaki's CVD diamond films, one of ordinary skill in this art would have been led to use an isotopically pure source of carbon 12 or carbon 13 in Yamazaki's CVD process to achieve this goal. Notwithstanding appellants' arguments in this record relating to the different methodology utilized by Seitz, we know of no technical reason⁸ why one of ordinary skill in this art would not have a

⁸ There is no objective evidence of record to show how or why low pressure as utilized in a CVD process would adversely affect a carbon isotope in such a process.

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reasonable expectation of successfully producing an isotopically pure diamond film having enhanced thermal conductivity when using an isotopically pure carbon source gas in the CVD process of Yamazaki. We, therefore, sustain the examiner's obviousness rejection of appealed claim 1.

We also agree with the examiner that the subject matter defined by appealed claims 3, 6, 7, 9, and 14 would have been obvious to a person of ordinary skill in this art based on the disclosures in Yamazaki and Seitz. Appealed claim 3 further specifies that the carbon atoms in the reaction gas comprise 99.9% or more ^{12}C . However, as emphasized above Seitz clearly teaches that the use of an isotope of only carbon 12 enhances the property of thermal conductivity. Further, based on this prior art teaching, one of ordinary skill in this art would have reasonably expected to obtain a coefficient of thermal conductivity for CVD diamond at least as high as required by appealed claim 6. In this regard, compare the disclosures of Strong at page 1843 inclusive of Figure 9. The subject matter of appealed claim 7 is suggested by the disclosure of the use of methanol, i.e., an alcohol, as a carbon source in Yamazaki's CVD process. Appealed claims 9 and 14 specify

various substrates which, we observe, may be used, inter alia, in "heat sink" applications. As observed above, it is known in the art to make use of a diamond layer in such applications. Accordingly, we agree with the examiner's conclusion that the subject matter defined by these claims would have been obvious within the meaning of 35 U.S.C. § 103.

We cannot sustain the obviousness rejections of appealed claims 4, 5, 8, 13 and 15. Claims 4, 5, 13, and 15 all specify that the nitrogen content in the produced diamond is 20 ppm or less. As appellants persuasively argue, the nitrogen content in Yamazaki's diamond ranges from 100 to 10,000 ppm which is much greater than the nitrogen content required by these claims. Moreover, Yamazaki provides nitrogen for the purposeful function of preventing lattice defects in the diamond, while it is appellants' purpose to avoid nitrogen contamination. See the specification at page 3, last paragraph. Under these circumstances, one of ordinary skill in the art would not have been led to reduce the required nitrogen content in Yamazaki's process. Accordingly, we cannot sustain the examiner's rejection of claims 4, 5, 13 and 15.

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Appealed claim 8 stands rejected under 35 U.S.C. § 103 as unpatentable over the combined teachings of Yamazaki, Seitz, and Sakamoto. This claim requires that the CVD method is effected using a carbon filament containing at least 99.9% of ^{12}C or ^{13}C . Thus, this claim implicitly is limited to a hot filament CVD technique (specification, page 3, line 1 and examples 13 and 14 at pages 22-24 of the specification) as contrasted to a microwave enhanced CVD technique as disclosed in Yamazaki. Since the microwave enhanced CVD technique utilizes an IR heater, not a carbon filament, there is no logical basis to support the argument that it would have been obvious to modify the Yamazaki CVD apparatus in the manner proposed by the examiner. Moreover, we find no disclosure in Sakamoto that the graphite utilized in this prior art vaporization process is either in the form of a filament or is as isotopically pure as required by the language of appealed claim 8. Thus, the obviousness rejection of appealed claim 8 fails for lack of an adequate factual basis.

In summary, the examiner's rejection of appealed claims 14 and 15 under the first paragraph of 35 U.S.C. § 112 is reversed. The examiner's rejection of appealed claims 1, 3, 6,

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7, 9, and 14 for obviousness is affirmed. The examiner's rejection of appealed claims 4, 5, 8, 13, and 15 for obviousness is reversed. Accordingly, the decision of the examiner is affirmed-in-part.

No period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

AFFIRMED-IN-PART

EDWARD C. KIMLIN)	
Administrative Patent Judge)	
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)	BOARD OF PATENT
JOHN D. SMITH)	APPEALS
Administrative Patent Judge)	AND
)	INTERFERENCES
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CHARLES F. WARREN)	
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APJ JOHN D. SMITH

APJ WARREN

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DECISION: AFFIRMED-IN-PART

Send Reference(s): Yes No
or Translation (s)

Panel Change: Yes No

Index Sheet-2901 Rejection(s):

Prepared: January 23, 2001

Draft Final

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OB/HD GAU

PALM / ACTS 2 / BOOK

DISK (FOIA) / REPORT